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SWITCH TO BE MOUNTED ON A DESIGN ELEMENT IN THE PASSENGER COMPARTMENT OF A MOTOR VEHICLE

Description

The invention relates to a switch to be mounted on a design element in the passenger compartment of a motor vehicle according to the preamble of patent claim 1. The switch according to the invention is characterised by a simple secure assembly process as well as by its significant lack of dependence on the design of the haptic element.

By haptic element is meant a structural group of the switch which contains the mechanical operating elements required for manually operating the switch. The haptic element can furthermore serve as a visual element, eg by suitably configuring the haptic element it is possible to make the function of the switch visible to the user.

From DE 197 38 656 A1 a switch is already known whose electrical or electronic switch elements and whose associated operating elements in the haptic element are positioned independently of each other on various parts of the vehicle door. They only come into active connection after the two parts have been fitted together. The drawback here however is that it is necessary to ensure a very close tolerance of the parts which support the switch element and haptic element which are to be connected together otherwise faulty positioning may have to be taken into account.

DE 43 13 030 A1 and US 5 805 402 describe groups of switches based on flexible printed conductors. They consist essentially of electrical switch elements which can preferably be in cases which are assigned a flexible foil touch panel or separate operating elements held in a console. Even with this technical solution bringing together the electrical switch elements and the haptic element requires considerable effort and great care. Furthermore switch blocks of this kind combined into groups considerably restrict the freedom of design since the geometrical arrangement of the individual switch elements determines the positioning of the operating elements of the haptic element. With many design specifications, such as are customary in the automotive industry, there is a great degree of variation in the foil-bound switch elements, unless one always proceeds from the variation having the highest design specification and does not connect up the corresponding switches where the design specifications are lower. However this leads to an undesirably high use of resources.

The object of the invention is to provide a switch to be mounted on a design element in the passenger compartment of a motor vehicle, for example on the inner trim of a door, which is cost-effective to manufacture and which can be fitted simply and securely and which can be adapted to any desired design.

According to the invention this is achieved through the features of patent claim 1.

According to this the zones of the flexible conductor which support the switch elements, and the zones or operating elements of the haptic element which are associated with these zones are designed so that the relevant zones can be positioned and fixed relative to each other and can be detached from each other. Furthermore these zones have no means for establishing a

permanent electrical circuit connection. Thus no permanent electrical contact is produced between the zones on the two sides.

The term "electrical" and "electronic" switch elements is thereby to include electro-magnetic and electro-optical switch elements.

According to a variation of the invention it is hereby proposed that the haptic element cannot be brought into an electrically conductive connection with the switch elements, i.e. the haptic element has no electrically conductive component parts which can be coupled electrically with the switch elements.

According to another variation of the invention the haptic element can only be brought into electrically conductive connection with the switch elements by actuating an operating element of the haptic element whereby the electrically conducting connection only exists for as long as the switch is located in the switching state produced by actuating the operating element ("switch closed"). With this variation of the invention the haptic element has no electrical structural elements in the narrower sense (such as e.g. a resistance, a transistor etc), but only a contact bridge in the form of a simple electrical conductor with which an electrical connection can be established between two switch elements.

According to a preferred embodiment of the invention the relevant zones of the conductor and haptic element are formed as mechanical plug connectors wherein a base member of the haptic element has a socket zone, such as e.g. a plug opening with which the zone of the flexible conductor supporting the switch elements can be brought into positive keyed engagement. To this end the zones of the flexible conductor supporting the switch elements has a mechanical reinforcement in the form of a frame around the

edges, a plate at the back or a cast element incorporating the relevant zone.

A cast element is suitable when using contactless switch systems, such as magneto-resistive sensors or inductive and capacitive close-range approach sensors. The cast element thereby offers in addition to good protection against mechanical damage also excellent protection against chemical attack and obviously against damp. This in turn guarantees that the switch has a high reliability and long service life.

Through suitably configuring the reinforcement which is connected to the flexible conductor, and also the close-fitting corresponding socket opening in the haptic element, the plug connection can only be established in the proposed position. Forming the reinforcement, whether it is by sticking a plate onto the reverse side of the conductor or by injection moulding a frame round the edge of the conductor or by casting the end region of the conductor, can be undertaken with high precision and efficiency by automated machines.

The mechanical reinforcements can also have detent elements for securing the insert position with regard to the haptic element, as well as means for sealing the plug-in zone against damp. When manufacturing such components it is possible to use twin component plastics injection moulding technology so that it is easier to meet the demands required for a seal through the softer of the two plastics.

A further embodiment of the invention proposes designing the zones of the flexible conductor supporting the switches, and the associated zone of the haptic element as a clamp-fit connection whereby a base body of the haptic element has a socket zone and a fixing element connectable therewith so that the zone of the flexible conductor

supporting the switch elements can be clamped between the socket zone of the haptic element and the fixing element. This can be undertaken for example by a fixing element which is connected in one piece with the base body through a film hinge of a plastics base body of the haptic element. After the corresponding zone of the flexible conductor has been supplied to the socket zone of the base body the fixing element can be swivelled towards the socket zone until its position is secured through detent elements and the conductor is thereby fixed with the switch elements relative to the position of the operating elements.

A further development of this embodiment proposes using a separate clamping plate as the fixing element. In this case the clamping plate should be provided with positive locking elements (e.g. studs) which are associated with matching detent openings (preferably around the edge) of the flexible conductor. These positive locking elements can be arranged so that only an exact positioning is possible between the clamping plate and conductor. The clamping plate is then fixed on the base body of the haptic element by means of a snap-fitting connection.

Basically all types of switch elements can be used if they are suitable for fitting flexible printed conductors. These can be formed for example as electrical contact faces which are allocated an electrical contact bridge which is connected to an operating element of the haptic element and closes the electric circuit when the operating element is actuated. Apart from the inductive and capacitive close-range approach switches and magneto-resistive structural elements (e.g. Hall element) already mentioned and which are each assigned a ferro-magnetic metal plate or a permanent magnet connected to an operating element of the haptic element, boxed switch elements are also suitable in the form of SMD switches or switch mats. Furthermore transponder readers are also

suitable as switch elements. Which type of switch is selected by the technician depends decisively on the technical requirements in each individual case.

At this point it should be pointed out that non-electrical principles can be used. By way of example the switch elements provided on the flexible conductor can be formed as passive or active optical elements which are assigned on the side of the operating elements of the haptic element means for reflection for the purpose of establishing an optical transmission path or means for interrupting an optical transmission path. Further processing of the switch signal is undertaken through the interposition of an opto-electrical converter.

Next to the switch elements there are where necessary further structural elements such as for example an optical element for lighting up the switch, a micro controller, resistances, diodes or the like.

The invention utilises the principle of the plug connection in order to establish in a simple reliable way an active connection between the switch elements and the operating elements of the haptic element without using at the same time (permanent-acting) electrical cable connections which are liable to breakdown. The configuration of the zones of the flexible conductor supporting the switch elements is entirely secondary to the configuration of the haptic element whilst simultaneously reducing the variety of designs on the switch side. I.e by means of the technical solution according to the invention (theoretically) any number of geometric arrangements of the operating elements of the haptic element can be fitted with only one variation of cable harness.

The invention will now be explained in further detail with reference to the embodiments shown in the drawings in which:

Figure 1 shows a flexible conductor with a reinforcement formed as a plate on the reverse side as well as boxed switch elements on the front side and haptic element with operating elements prior to connection with the switch;

Figure 2 is as Figure 1, but with electrical contact faces as the switch element;

Figure 3 shows a flexible conductor for clamp fitting on the base body of the haptic element by means of a clamping plate which is swivel mounted on the base body and can be locked therewith;

Figure 4 similar to Figure 3, but with a separate clamping plate;

Figure 5 shows a diagrammatic illustration of a flexible conductor with a close-range approach switch or the like wherein the plug area is formed by a cast element;

Figure 6 shows a diagrammatic view of a flexible conductor with switch elements in the form of a boxed touch panel and a plug zone formed as a cast element wherein the cast element has recesses in the region of the touch panel;

Figure 7 shows a diagrammatic view of a flexible conductor with a reinforcement plate stuck onto the underneath to form the plug zone;

Figure 8 shows a diagrammatic view of a flexible conductor with a plug zone formed by a frame around the edge;

Figure 9 shows a diagrammatic view of a flexible conductor with a plate moulded onto the underneath and with a sealing element closing the plug zone, as well as with detent elements fixing the plug-in position in the haptic element;

Figure 10 shows a diagrammatic view of a flexible conductor with a clamping zone which has perforations for positioning the switch elements accurately relative to the haptic element;

Figure 11 shows a diagrammatic view of a flexible conductor which is divided up into three arms with plug zones at the ends for different functioning units.

Mounting electrical and electronic structural elements 3a, 3b, 21, 22, 23, 24 on flexible conductor plates or conductors 2, 2a, 2b, 2c is carried out by automatic manufacturing equipment which can be adapted to the various different requirements of the component parts which are to be fitted. Thus it can also be envisaged that the plug zones 20 or clamping zones 20' can be formed in the same production line. The relevant zones are then immediately available for connecting to a suitably adapted haptic element.

Figure 1 shows a flexible conductor 2 having conducting paths 200 to which are connected two boxed switch elements 21, 21' (constructed as buttons) and an optical element 3a (e.g. light diode) for illuminating the switch. On the back of the conductor 2 there is a reinforcement 123 in the form of a plate which is stuck on and stabilises the plug zone 20 which supports the switch elements 21, 21' and is associated with a slit-like plug zone 12 of the base body 10 of the haptic element 11. Detent and sealing

elements can, analogous with Figure 9, be connected to the reinforcement 123 to ensure secure fixing of the plug zone 20 in the haptic element as well as an effective seal against damp.

After introducing the plug zone 20 into the socket zone 12 of the base body 10 of the haptic element 1 an active connection is established between the switch elements 21, 21' and the operating element 11. If finger pressure is applied to one of the zones of the operating element 11 marked by the arrows ((or () then this zone flips in the direction of the corresponding switch element 21 or 21' and thereby actuates the sensor element 21a which leads to a switch signal. Once the operating pressure has ceased the operating element 11 automatically returns to its starting position whereby the switch signal is interrupted.

The embodiment of Figure 2 corresponds substantially to that of Figure 1. Only the switch elements 22, 22' are designed as electrical contact faces which are each assigned a contact bridge (not shown) from the inside of the operating element 11. A switch signal is thus produced by short-circuiting the adjoining and slightly spaced contact faces 22 and 22'. When using this embodiment in surroundings which are susceptible to damp and possibly to particles of dirt, e.g. in the wet space of a vehicle door, a seal has to be provided around the edge of the socket area 12 of the haptic element 1. For this not only are the means available which are already mentioned in the description relating to Figure 1, but also there is the possibility of integrating a seal (e.g. through 2-component injection moulding) in the base body 10 of the haptic element since the switch elements 22 which are formed as contact faces do not really cause any extra thickness compared with the boxed switch elements 21 (see Figure 1) which might hinder the insertion of the plug zone 20 into the base body 10.

The variation of the invention shown in Figure 3 uses a clamping connection instead of a plug-in connection between the conductor 2 and haptic element. According to the variation here a fixing element 12' designed as a clamping plate is attached to the base body 10 of the haptic element 1' through a film hinge 12b and after positioning the clamping zone 20 of the flexible conductor 20 relative to the socket zone 120 of the haptic element 1' the fixing element can be fixed on the base body 10 through the detent elements 10a, 12a. This produces a clamping fixing of the conductor 2 on the haptic element 1'. The film hinge 12b could be used as a stop for correctly positioning the conductor 2.

As opposed to this, the switch in Figure 4 uses a separate fixing element 12'' which should preferably be provided with positive locking elements (not shown) which can engage in positioning openings of the flexible conductor (analogous with Figure 10). After clipping the fixing element 12'' onto the base body 1'' a permanently correct positioning of the switch elements 22, 22' relative to the operating element 11 is guaranteed.

When using a clamping connection between the zone 20' and the base body 10 a mechanical reinforcement is no longer required.

Figure 5 shows a mechanical reinforcement 121 in the form of a case element (e.g. based on an epoxy resin or plastics) which completely encases the plug zone and in which an electronic contactlessly operating switch 23 (e.g. Hall element) is embedded which reacts to close range approach of the associated zone of the operating element 11 or a part connected thereto. Furthermore an optical element is provided for illuminating the switch.

In the embodiment of Figure 6 recesses were provided in the case element 122 in the region of the switch elements 24, 24' formed as buttons (analogous with Figure 1), to allow access and thus operation through the operating element 11. Depending on requirements further electronic structural elements 3b are included in the cast element. In order to reliably avoid a false execution of the plug fitting process the contours of the mechanical reinforcements 121, 122, 123, 124, 125 and socket openings 12 of the base body 10 should be matched with each other along the lines of the key principle.

Figure 7 corresponds substantially to a combination of the mechanical reinforcement 123 of Figure 1 and the fitting out of electronic structural elements according to Figure 5.

Figure 8 shows a mechanical reinforcement in the form of a frame 124 which is connected to the side edge of the conductor 2, for example by injection moulding or even by sticking.

The reinforcement shown in Figure 9 consists of a plate 125 connected to the underneath of the conductor and provided on its inner edge with a moulded seal 125a having detent elements 125b. In conjunction with a haptic element similar to Figure 1 and adapted detent elements of the base body it is possible to guarantee a permanent secure positioning of the switch elements 22, 22' relative to the operating element 11. The seal 125a keeps out dirt and damp from the electrical and electronic structural elements.

One example of a flexible conductor 2 for clamp fixing on a haptic element is shown in Figure 10. According to this perforations 126 are formed in the clamping area 20' of the conductor 2 and are associated with detent pins (not shown) on a fixing element 12''. The different patterns of perforations 126 in the two edges guarantees accurate positioning of the conductor 2 relative to the fixing element 12'' and thus also to the operating element 11.

The diagrammatic illustration of Figure 11 shows a conductor 2 split up into three conductor arms 2a, 2b, 2c. The end zones 4, 5, 6, 7 are each assigned different functions. For a cable inserted in a vehicle door on the drive side for example the zone could be connected to a switch module which is provided for operating the front and rear window lifters, the mirror and the child lock. Unlocking the petrol tank could be assigned to the zone 5 of the conductor arm 2b. Finally the zones 6 and 7 can be connected to indicator instruments showing the state of the door locks.

LIST OF REFERENCE NUMERALS

1	Haptic element
1'	Haptic element
1''	Haptic element
10	Base body of haptic element
10a	Detent element
11	Operating element, sensor button
12	Socket zone, plug zone
12'	Fixing element; plate, integrated and swivel mounted in base body
12''	Fixing element; plate, separate
12a	Detent element
120	Socket zone
121	Cast element
122	Cast element
123	Reinforcement element, full surface on one side
124	Reinforcement element, around the edges
125	Reinforcement element, full surface on one side
125a	Sealing element
125b	Detent element, clip element
126	Positioning means, recess, perforation
2	Flexible conductor
2a	Flexible conductor
2b	Flexible conductor
20	Zone supporting switch elements; plug zone
20'	Zone supporting switch elements; clamping zone
21	Switch element
21a	Sensor element
22	Switch element
23	Switch element
24	Switch element
200	Conductor path

3a	Optical element
3b	Electronic component part (any type)
4	Zone associated with haptic element
5	Zone associated with haptic element
6	Zone associated with haptic element
7	Zone associated with haptic element